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|------------|--------------|---------------------------------|
| DTC | P0171 | System Too Lean (Bank 1) |
| DTC | P0172 | System Too Rich (Bank 1) |

DESCRIPTION

The fuel trim is related to the feedback compensation value, not to the basic injection time. The fuel trim consists of both the short-term and the long-term fuel trims.

The short-term fuel trim is fuel compensation that is used to constantly maintain the air-fuel ratio at stoichiometric levels. The signal from the Air-Fuel Ratio (A/F) sensor indicates whether the air-fuel ratio is rich or lean compared to the stoichiometric ratio. This triggers a reduction in the fuel injection volume if the air-fuel ratio is rich and an increase in the fuel injection volume if it is lean.

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Factors such as individual engine differences, wear over time and changes in operating environment cause short-term fuel trim to vary from the central value. The long-term fuel trim, which controls overall fuel compensation, compensates for long-term deviations in the fuel trim from the central value caused by the short-term fuel trim compensation.

If both the short-term and long-term fuel trims are lean or rich beyond predetermined values, it is interpreted as a malfunction, and the ECM illuminates the MIL and sets a DTC.

| DTC No. | DTC Detection Conditions | Trouble Areas |
|---------|---|--|
| P0171 | With warm engine and stable air-fuel ratio feedback, fuel trim considerably in error to lean side (2 trip detection logic) | <ul style="list-style-type: none"> • Air induction system • Injector blockage • Mass Air Flow (MAF) meter • Engine Coolant Temperature (ECT) sensor • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater (sensor 1) • Integration relay (EFI MAIN relay) • A/F sensor heater and EFI MAIN relay circuits • PCV valve and hose • PCV hose connections • ECM |
| P0172 | With warm engine and stable air-fuel ratio feedback, fuel trim considerably in error to rich side (2 trip detection logic) | <ul style="list-style-type: none"> • Injector leakage or blockage • MAF meter • ECT sensor • Ignition system • Fuel pressure • Gas leakage from exhaust system • Open or short in A/F sensor (sensor 1) circuit • A/F sensor (sensor 1) • A/F sensor heater (sensor 1) • Integration relay (EFI MAIN relay) • A/F sensor heater and EFI MAIN relay circuits • ECM |

HINT:

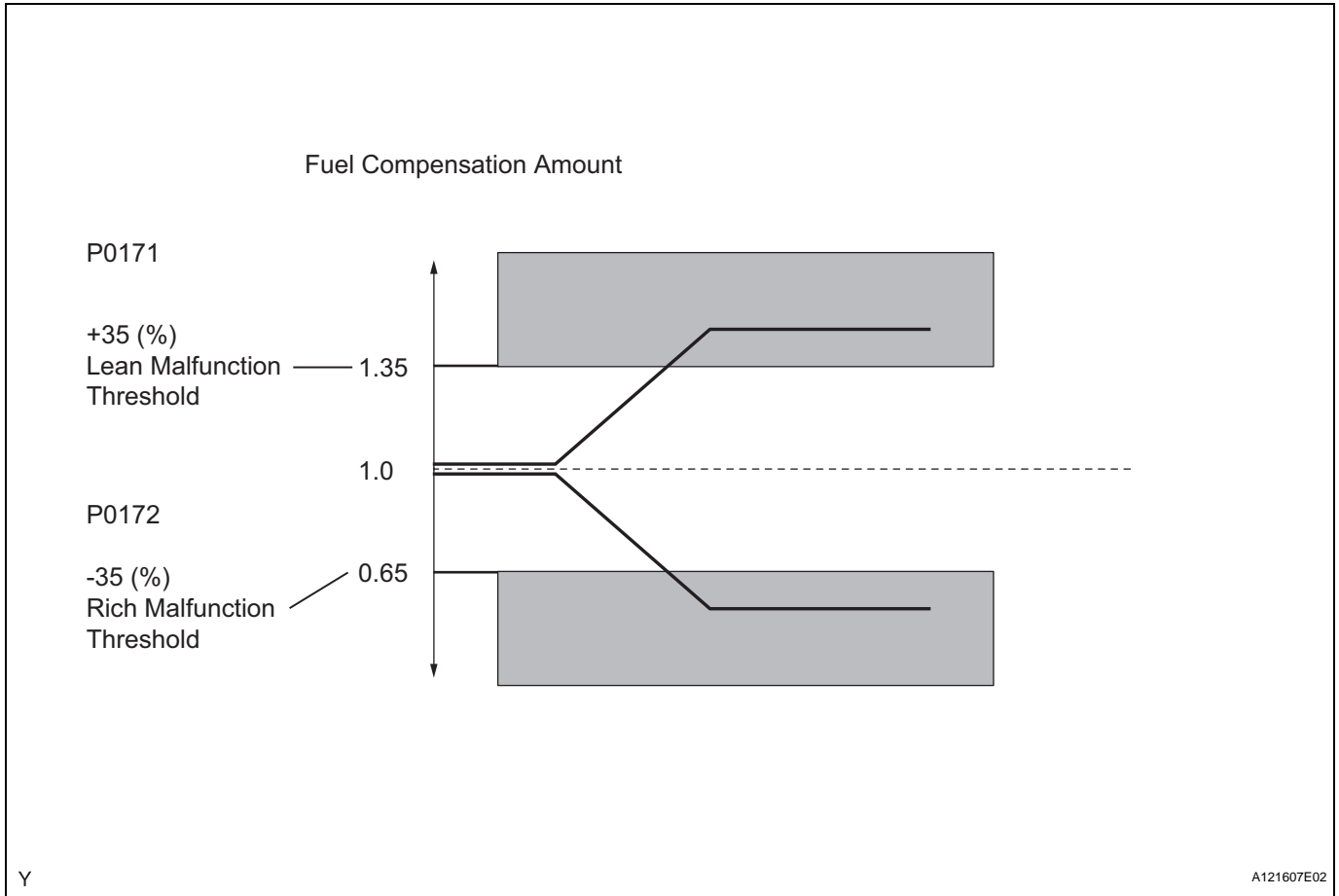
- When DTC P0171 is set, the actual air-fuel ratio is on the lean side. When DTC P0172 is set, the actual air-fuel ratio is on the rich side.
- If the vehicle runs out of fuel, the air-fuel ratio is lean and DTC P0171 may be set. The MIL is then illuminated.
- When the total of the short-term and long-term fuel trim values is within 20 % (and the engine coolant temperature is more than 75°C [167°F]), the system is functioning normally.

MONITOR DESCRIPTION

Under closed-loop fuel control, fuel injection volumes that deviate from those estimated by the ECM cause changes in the long-term fuel trim compensation value. The long-term fuel trim is adjusted when there are persistent deviations in the short-term fuel trim values. Deviations from the ECM's estimated fuel injection volumes also affect the average fuel trim learning value, which is a combination of the average short-term fuel trim (fuel feedback compensation value) and the average long-term fuel trim (learning value of the air-fuel ratio). If the average fuel trim learning value exceeds the malfunction threshold, the ECM interprets this as a fault in the fuel system and sets a DTC.

Example:

The average fuel trim learning value is +35 % or more or -35 % or less, the ECM interprets this as a fuel system malfunction.



MONITOR STRATEGY

| | |
|---------------------------------------|---|
| Related DTCs | P0171: Fuel trim lean P0172: Fuel trim rich |
| Required Sensors/Components (Main) | Fuel system |
| Required Sensors/Components (Related) | A/F sensor, Mass air flow meter, Crankshaft position sensor |
| Frequency of Operation | Continuous |
| Duration | Within 10 seconds |
| MIL Operation | 2 driving cycles |
| Sequence of Operation | None |

TYPICAL ENABLING CONDITIONS

| | |
|--|--|
| Monitor runs whenever following DTCs not present | P0010 (VVT OCV) P0011 (VVT System 1 - Advance) P0012 (VVT System 1 - Retard) P0031, P0032 (A/F sensor heater - Sensor 1) P0100 - P0103 (MAF meter) P0115 - P0118 (ECT sensor) P0120 - P0223, P2135 (TP sensor) P0125 (Insufficient ECT for Closed Loop) P0335 (CKP sensor) P0340 (CMP sensor) P0351 - P0354 (Igniter) P0500 (VSS) |
| Fuel system status | Closed loop |
| Battery voltage | 11 V or more |
| Either of following conditions 1 or 2 set | - |
| 1. Engine RPM | Below 1,100 rpm |
| 2. Intake air amount per revolution | 0.22 g/rev or more |
| Catalyst monitor | Not executed |

TYPICAL MALFUNCTION THRESHOLDS

| | |
|--|---------------------------------|
| Purge-cut | Executing |
| Either of following conditions 1 or 2 met | - |
| 1. Average of short-term fuel trim and long-term fuel trim | 35 % or more (varies with ECT) |
| 2. Average of short-term fuel trim and long-term fuel trim | -35 % or less (varies with ECT) |

WIRING DIAGRAM

Refer to DTC P2195 (see page [ES-296](#)).

INSPECTION PROCEDURE

HINT:

- Read freeze frame data using the intelligent tester. Freeze frame data records the engine condition when malfunctions are detected. When troubleshooting, freeze frame data can help determine if the vehicle was moving or stationary, if the engine was warmed up or not, if the air-fuel ratio was lean or rich, and other data from the time the malfunction occurred.
- A low A/F sensor voltage could be caused by a rich air-fuel mixture. Check for conditions that would cause the engine to run rich.
- A high A/F sensor voltage could be caused by a lean air-fuel mixture. Check for conditions that would cause the engine to run lean.

| | |
|----------|--|
| 1 | CHECK ANY OTHER DTCS OUTPUT (IN ADDITION TO DTC P0171 OR P0172) |
|----------|--|

- Connect the intelligent tester to the DLC3.
- Turn the ignition switch ON and turn the tester ON.
- Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DTC INFO / CURRENT CODES.
- Read DTCs.

Result

| Display (DTC Output) | Proceed To |
|-------------------------------|------------|
| P0171 or P0172 | A |
| P0171 or P0172 and other DTCs | B |

HINT:

If any DTCs other than P0171 or P0172 are output, troubleshoot those DTCs first.

B

GO TO DTC CHART

A

2

PERFORM ACTIVE TEST USING INTELLIGENT TESTER (A/F CONTROL)

- Connect the intelligent tester to the DLC3.
- Start the engine and turn the tester ON.
- Warm up the engine at an engine speed of 2,500 rpm for approximately 90 seconds.
- On the tester, select the following menu items:
DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL.
- Perform the A/F CONTROL operation with the engine in an idling condition (press the RIGHT or LEFT button to change the fuel injection volume).
- Monitor the output voltages of A/F and HO2 sensors (AFS B1S1 and O2S B1S2) displayed on the tester.

Result:

The A/F sensor reacts in accordance with increases and decreases in the fuel injection volume:

+25 % = Rich output:









Less than 3.0 V



-12.5 % = Lean output:

More than 3.35 V

NOTICE:

The A/F sensor has an output delay of a few seconds and the HO2 sensor has a maximum output delay of approximately 20 seconds.

| Case | A/F Sensor (Sensor 1) Output Voltage | | HO2 Sensor (Sensor 2) Output Voltage | | Main Suspected Trouble Areas |
|------|---|---|--|---|---|
| 1 | Injection Volume +25 % -12.5 % |  | Injection Volume +25 % -12.5 % |  | - |
| | Output Voltage More than 3.35 V Less than 3.0 V |  | Output Voltage More than 0.5 V Less than 0.4 V |  | |
| 2 | Injection Volume +25 % -12.5 % |  | Injection Volume +25 % -12.5 % |  | <ul style="list-style-type: none"> A/F sensor A/F sensor heater A/F sensor circuit |
| | Output Voltage Almost no reaction |  | Output Voltage More than 0.5 V Less than 0.4 V |  | |

| Case | A/F Sensor (Sensor 1) Output Voltage | | HO2 Sensor (Sensor 2) Output Voltage | | Main Suspected Trouble Areas |
|------|---|---|---|--|---|
| 3 | Injection volume +25 % -12.5 % |  | Injection Volume +25 % -12.5 % |  | Extremely rich or lean actual air-fuel ratio <ul style="list-style-type: none"> • Injector leakage or blockage • Gas leakage from exhaust system • Fuel pressure • MAF meter • ECT sensor • Air induction system • PCV hose connections |
| | Output Voltage Almost no reaction | —————NG | Output Voltage Almost no reaction | —————NG | |

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Following the A/F CONTROL procedure enables technicians to check and graph the voltage outputs of both the A/F and HO2 sensors.

To display the graph, select the following menu items on the tester: DIAGNOSIS / ENHANCED OBD II / ACTIVE TEST / A/F CONTROL / USER DATA / AFS B1S1 and O2S B1S2; then press the YES button and then the ENTER button followed by the F4 button.

Result

| Result | Proceed To |
|--------|------------|
| Case 1 | C |
| Case 2 | B |
| Case 3 | A |

B

Go to step 11

C

Go to step 15

A

3

READ VALUE USING INTELLIGENT TESTER (MAF)

- Connect the intelligent tester to the DLC3.
- Turn the ignition switch ON and turn the tester ON.
- Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / MAF and COOLANT TEMP.
- Allow the engine to idle until the COOLANT TEMP reaches 75°C (167°F) or more.
- Read the MAF with the engine in an idling condition and at an engine speed of 2,500 rpm.

Standard:

MAF while engine idling: Between 1 g/sec. and 3 g/sec. (shift position: N, A/C: OFF).

MAF at engine speed of 2,500 rpm: Between 2 g/sec. and 6 g/sec. (shift position: N, A/C: OFF).

NG

REPLACE MASS AIR FLOW METER

OK

4 READ VALUE USING INTELLIGENT TESTER (COOLANT TEMP)

- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch ON and turn the tester ON.
- (c) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / COOLANT TEMP.
- (d) Read the COOLANT TEMP twice, when the engine is both cold and warmed up.

Standard:

With cold engine: Same as ambient air temperature.

With warm engine: Between 75°C and 100°C (167°F and 212°F).

NG**REPLACE ENGINE COOLANT TEMPERATURE SENSOR****OK****5 CHECK PCV HOSE CONNECTIONS**

- (a) Check for PCV hose connections.

OK:

PCV hose is connected correctly and is not damaged.

NG**REPAIR OR REPLACE PCV HOSE****OK****6 CHECK AIR INDUCTION SYSTEM**

- (a) Check the air induction system for vacuum leakage.

OK:

No leakage from air induction system.

NG**REPAIR OR REPLACE AIR INDUCTION SYSTEM****OK****7 CHECK FOR SPARKS AND IGNITION (See page ES-171)****NG****REPAIR OR REPLACE IGNITION SYSTEM****OK****8 CHECK FOR EXHAUST GAS LEAK**

- (a) Check for exhaust gas leakage.

OK:
No gas leakage.

NG → REPAIR OR REPLACE EXHAUST SYSTEM

OK

9 CHECK FUEL PRESSURE

(a) Check the fuel pressure (see page FU-6).
Standard pressure:
304 to 343 kPa (3.1 to 3.5 kgf/cm², 44.1 to 49.7 psi)

NG → REPAIR OR REPLACE FUEL SYSTEM

OK

10 INSPECT FUEL INJECTOR (INJECTION AND VOLUME)

(a) Check the injection volume (see page FU-11).
Standard injection volume:
45 to 58 cm³ (2.9 to 3.5 cu in.) per 15 seconds

NG → REPLACE FUEL INJECTOR

OK

11 INSPECT AIR-FUEL RATIO SENSOR (HEATER RESISTANCE) (See page ES-83)

NG → REPLACE AIR-FUEL RATIO SENSOR

OK

12 INSPECT INTEGRATION RELAY (EFI RELAY) (See page ES-84)

NG → REPLACE INTEGRATION RELAY

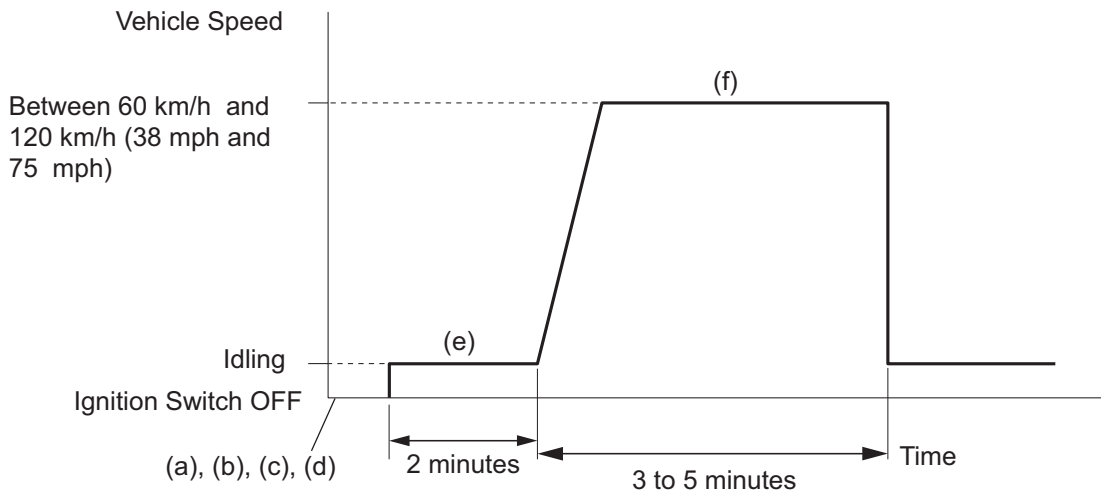
OK

13 CHECK HARNESS AND CONNECTOR (A/F SENSOR - ECM) (See page ES-310)

NG → REPAIR OR REPLACE HARNESS OR CONNECTOR

OK

ES

14 REPLACE AIR-FUEL RATIO SENSOR**NEXT****15 PERFORM CONFIRMATION DRIVING PATTERN****ES**

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- (a) Connect the intelligent tester to the DLC3.
- (b) Turn the ignition switch ON and turn the tester ON.
- (c) Clear DTCs (see page [ES-35](#)).
- (d) Switch the ECM from normal mode to check mode using the tester (see page [ES-38](#)).
- (e) Start the engine and warm it up with all the accessories switched OFF.
- (f) Drive the vehicle at between 60 km/h and 120 km/h (38 mph and 75 mph) and at an engine speed of between 1,400 rpm and 3,200 rpm for 3 to 5 minutes.

HINT:

If the system is still malfunctioning, the MIL will be illuminated during step (f).

NOTICE:

If the conditions in this test are not strictly followed, no malfunction will be detected.

NEXT

16

CHECK WHETHER DTC OUTPUT RECURS (DTC P0171 OR P0172)

- (a) On the intelligent tester, select the following menu items:
DIAGNOSIS / ENHANCED OBD II / DTC INFO /
CURRENT CODES.
- (b) Read DTCs.

Result

| Display (DTC Output) | Proceed To |
|----------------------|------------|
| No output | A |
| P0171 or P0172 | B |

